MAMMOGRAPHY PROCEDURE AND APPARATUS FOR REDUCING PAIN WHEN COMPRESSING BREAST

This application claims the priority filing date of US provisional application Ser. No. 60/534,603 filed on 01/06/2004 by the applicant herein.

Background of Invention:

The invention refers to a new method and apparatus used when compressing a patient's breast for taking a radiographic image. As is known, in mammography it has been found that firm compression of the breast is essential for good quality X-ray imaging. Firm compression spreads out the breast tissue, thereby reducing superimposed structures. Also as is known, low dosage

X-rays as used in mammography can more easily penetrate a thinner mass.

Women are advised to undergo periodic mammography screening (examination) for purposes of detecting cancer at its earliest stages. However because of the harsh breast compression techniques, patients consider mammograms to be uncomfortable and even painful and are therefore reluctant to schedule screenings after they once experience the procedure.

A variety of methods have been tried in an effort to ease the patient's pain. One method that is tried is to allow the patient to control some facet of the breast compressive forces. Another method is to train the technician to be more sensitive and more sympathetic to each particular patient's demeanor. Still, another method is to provide a breast cushion pad as disclosed in US Patents Nos. 5,185,776 and 5,377,254 and 6,577,702. Also a unique type of machine for improving the mammography procedure was disclosed in US Patent No. 5,590,166 wherein the bucky, and the compression paddle, are both movable toward each other to compress the breast.

The present invention is directed to the same important purpose as the foregoing systems and methods; that is, the invention is directed to making the mammography procedure more comfortable and less painful for the patient. Also, the inventive method is less painful, requires minimal additional accessories for a mammography machine equipment, and requires

minimal additional training or experience in utilizing the method. Further, the quality of the images as provided by the digital detectors or film of the X-ray machine are improved since, with the new compression technique, the mass of the breast will tend to be spread out somewhat more evenly than in prior art procedures. Also, the unique breast interface and compression pad disclosed herein will, per se, tend to be more comfortable to the patient.

Summary of the Invention:

A method and apparatus are disclosed wherein an inflatable breast interface element mounted on the bucky is selectively inflated and moved toward the associated compression paddle during the breast compression procedure to provide cooperating, more evenly distributed, and more comfortable compressive and shear forces to the breast.

The foregoing features and advantages of the present invention will be apparent from the following more particular description of the invention. The accompanying drawings, listed herein below, are useful in explaining the invention.

Drawings:

Fig. 1 is a sketch showing the inventive pad mounted on a standard mammography machine wherein the bucky (mounted on the C-arm) is fixed relative to the compression paddle;

Fig. 2 is a sketch, labeled prior art, showing a mammography machine as disclosed in US Patent No. 5,590,166 wherein the bucky is movable relative to the compression paddle;

Fig. 3 is a sketch indicating a compression paddle compressing a patient's breast a desired amount;

Fig. 4 is a sketch showing the compression paddle in a position to compress the breast less than the full desired amount;

Fig. 5 is a sketch showing the position of the bucky lifting the breast toward the compression paddle in accordance with the method of the invention, and in dotted lines the position of the bucky as in the prior methods;

Fig. 6 shows a sketch of a breast useful in explaining the method of the invention.

Fig. 7 is a sketch depicting, by the arrow line the compression and shear forces on a patient's breast as in prior methods;

Fig. 8 depicts the complementary and cooperating compression forces developed by moving (elevating) the bucky, in accordance with the inventive method;

Figs. 9 depicts an inflatable pad in accordance with the invention;

Fig. 10 shows a side view of the pad of Fig. 9 positioned on an associated bucky;

Fig. 11 shows a view of the pad of Fig. 9 in an inflated and

expanded mode;

Fig. 12 shows a view of another embodiment of the inventive pad in an inflated mode;

Fig. 13 shows a view of the pad of Fig. 12 in a partially inflated mode;

Fig. 14 is relatively exaggerated view of a cross section of the pad of Fig. 12 mounted on a associated bucky;

Fig. 15 shows another embodiment of the inventive pad;

Fig. 16 is a front view of the pad of Fig. 15 in an inflated mode, but omitting the front and side tabs shown in Fig. 15;

Fig. 17 is a side view of the pad of Fig. 15 in an inflated mode, again omitting the front and side tabs;

Fig. 18 is a side view of the pad of Fig. 15 in a partially inflated mode, again omitting the front tabs;

Fig. 19 is another embodiment of the inventive pad;

Fig. 20 is a front view of the pad of Fig. 19, but omitting the front tab;

Fig. 21 is a side view of the pad of Fig. 19,again omitting the front tab;

Fig. 22 shows the partially inflated and expanded inventive pad as mounted on the bucky as an interfacing surface for a patient's breast; and

Fig. 23 shows the fully inflated and expanded pad compressing a patient's breast.

Description of the Invention:

Fig. 1 depicts a standard mammography machine 10. The machine 10 includes a C-arm 11 mounted on a base 12. An X-ray source 13 is mounted on the upper end of the C-arm 11, and a bucky 15 is mounted on the lower end of the C-arm 11. The bucky is fixed or stationary relative to the C-arm. It is of course known that the C-arm including the bucky is rotatable or tiltable such as for taking oblique images of the breast. Bucky 15 contains a suitable known type of image detecting and recording device 19 such as a digital image detector or film cassette, depicted by reference 19 in Fig. 3. The bucky 15 is oriented to provide a support table for the patient's breast during the mammography procedure; the patient is depicted by the dotted lines of the pictorial diagram of Fig. 1.

While the bucky is stationary or fixed, a breast compression paddle 14 that is also mounted on the C-arm is movable relatively toward and away from the bucky 15. The compression paddle 14 includes a bottom surface that is operated to push and compress the patient's breast between the paddle 14 and the bucky 15.

Refer now to Fig. 2 that shows a mammography machine 10A as disclosed in US Patent No. 5,590,166 that is generally similar to the mammography machine 10 of Fig. 1. However, a significant distinction between the machine 10 and machine 10A is that in machine 10 the bucky is stationary or fixed on the C-arm 11. In contrast, in machine 10A the bucky is movable on the C-arm 11A.

As indicated by the lettering "A" in Fig. 2, the bucky 15 of machine 10A is movable toward and away from the compression paddle 14. Also, as indicated by the lettering "B" the compression paddle 15 is movable toward and away from bucky 15. Patent No. 5,590,166 states that machine 10A includes a linear motorized drive to move the compression paddle 14 and the bucky 15 simultaneously in opposite directions at a substantially equal speed for compressing the breast between the compression paddle and the bucky.

A first step in the mammography procedure for taking a craniocaudal image is to position the patient's breast 16 on the bucky 15 such that the weight (mass) of the breast is supported on the bucky. As indicated in Fig, 3, a next step is to firm the compression paddle 14 against the chest wall, the upper surface of the breast and the suspensory ligaments of the breast. Next, the compression paddle 14 is caused to move down substantially parallel to, and adjacent the chest wall, and engage the upper posterior portion of the breast to push and force the breast downwardly. As noted in Fig. 3, the breast is compressed to provide a desired spacing, indicated as "X", between the compression paddle 14 and bucky 15 to obtain the desired compression of the breast for taking an X-ray image. The foregoing actions develop compression and shear forces on the chest wall and the breast. As is known, the human skin does not stretch easily, and dependent on the size of the breast and the

condition of the muscles and ligaments, the shear forces applied can be substantial as the compression paddle 14 is forced down to compress the breast in a position required for taking an X-ray image. Patients often complain that the required compression of the breast for taking the X-ray image is quite painful.

The inventive method, will first be described in relation to the mammography machine 10A as shown in Fig. 2 wherein the bucky 15 is movable relative to the compression paddle 14. In the inventive method, the breast is positioned on the breast supporting surface of the bucky and the compression paddle is moved to compress the breast, as in previous methods. Importantly however in the inventive method, before the full desired selected compression of the breast is attained, the movement of the compression paddle is paused or stopped at an intermediate position where less than full desired compression is obtained, see Fig. 4. Next, the bucky is then moved toward the paddle to obtain the full desired compression, see Fig. 5.

Figs. 4 and 5, graphically show the inventive method. Less than the full desired compression, mentioned above, is indicated in Fig. 4 as "X + Y"cm. It should be understood that because of the different sizes, configurations and firmness of patients' breasts both "X" and "Y" are variables. The technician must adjust for each breast. At this intermediate position, it is approximated that 70% to 85% of the desired compression has been attained. Note also that the indicated percentages of

compression are not preset, but rather a technician has to determine the amount of compression through experience and training based on the required compression for proper imaging, and the patient's comfort.

Patients usually appear to sense most of the pain at the higher compressive forces, and the patients appear to sense much lesser pain or discomfort at the intermediate position of the sequence, as indicated in Fig. 4. At this intermediate position of the paddle (as indicated in Fig. 4) the breast has not been sufficiently compressed for taking the X-ray image. In the next step of the inventive procedure, movement of the paddle 14 is paused or stopped at this intermediate position, and the paddle itself now becomes a fixed upper support against which the breast is compressed. In the following step, as depicted in Fig. 5, the breast supporting surface of the bucky 15 is caused to move upwardly from its initial position indicated by the dotted lines to the position indicated by the solid lines, to compress the breast there between. The breast supporting surface of the bucky 15 is moved toward the compression paddle 14 a distance of"Y" cm, an amount equal to the amount necessary to compress the breast to a position to provide the desired separation "X". The breast is now at a position for taking an X-ray image.

Essentially, in this latter step of the inventive method the initial roles of the compression paddle and the bucky are reversed; the compression paddle becomes a stationary reference

surface. The breast supporting surface of the bucky is moved to apply the additional compressive force to the sagittal section (underside) 20 of the breast. Refer to Fig. 6 that shows an outline of a patient's breast.

The inventive method thus tends to decrease the compressive and shear forces applied to the upper section of the breast including the pectoralis major muscles and suspensory ligaments of the breast, see Fig. 22, and in so doing reduces the pain felt by the patient.

To further explain the advantages of the inventive method, refer now also to Figs. 7 and 8 as well as Fig. 6. Note that as indicated in Fig. 6, the sagittal section 20 of the breast is normally lower than the inframammary fold 21 that joins the sagittal section to the chest wall. As depicted in Fig. 7, in the mammography procedure, when the breast is positioned on the bucky, the inframammary fold 21 and the sagittal section 20 are essentially level with the upper surface of the bucky. In the prior methods when the compression paddle 14 is lowered toward the bucky 15 essentially all the compressive and shear forces are applied to the top of the breast; that is, the forces are effective on the suspensory ligaments, tissue and muscles of the breast, see Fig. 7. There are but limited compressive and shear forces on the sagittal section 20 of the breast and on the tissue and ligaments adjacent the inframammary fold 21.

The inventive method provides a procedure for distributing

the compressive and shear forces applied to the breast when taking an X-ray image. More specifically, in the inventive method after the compression paddle 14 is stopped at an intermediate position, the breast supporting surface of the bucky 15 is caused to move up to provide an active compression force to the sagittal section 20 of the breast. This is indicated in Fig. 8 by the arrow line, marked complementary and cooperating compression forces. Movement of the breast supporting surface of bucky 15 upwardly compensates for the distance that the compression paddle 14 would have moved in the prior methods. As depicted in Fig. 8, compression and shear forces will still be applied to the top muscles and ligaments of the breast which will tend to be stretched, but much more moderately. Note that as the upper support surface of the bucky is caused to move up, the tissue and ligaments on the sagittal section 20 and the adjacent chest wall will also be subjected to shearing and compressive forces. However, the level of these shearing and compressive forces will be relatively more distributed and balanced; and, the forces applied to the upper posterior of the breast will be substantially less than the forces applied by the prior art.

As stated above, since the size and types of patients' breast vary so considerably, the actual distance of movement of the breast supporting surface of the bucky also varies.

For present purposes, the breast may be considered as a

non symmetrical object effectively mounted (suspended) on a wall. The breast is principally suspended by muscle, ligaments and tissue that extend from the chest wall above the breast, see Fig. 6. In prior mammography compression procedures, the sagittal section of the breast has been "passively" supported on the bucky, and all the compressive forces have been applied to the upper posterior section of the breast, see Fig. 7. During the compression procedure, as the compression paddle is moved to compress the breast, the edge of the paddle engages the upper posterior section of the breast at an angle, and the compressive and shear forces that are developed by the paddle will tend to stretch the muscle, ligaments and tissue of the upper posterior of the breast while minimal forces are effective on the sagittal section of the breast. As the compression paddle is moved, the shear forces tending to cause stretching of the muscles, ligaments and tissue suspending the breast are a major source of the pain experienced by the patient. During this same period of paddle movement, other portions of the breast including the sagittal section may only be minimally stressed. Thus, a basic principle of the invention is to more evenly distribute the forces applied to the breast during the compression procedure. This reduces the shear forces applied to the breast suspending muscle, ligaments and tissue and applies additional compressive forces to other parts of the breast. The total effective compression force on the breast remains essentially the same.

The machine 10A disclosed in US Patent No. 5,590,166 states that the compression paddle and the bucky are moved at equal speeds in opposite directions for compressing the breast. This suggests an action such as that of closing a pair of pliers on a symmetrical object to provide the compression. In contrast to the movement as suggested is said patent, the present invention moves the compression paddle and bucky different distances at different speeds. This compensates for the different structure and sensitivities of the various sections of the breast to thus reduce pain and discomfort during the compression procedure.

The inventive method has been described utilizing a mammography machine having a bucky that is movable relative to the compression paddle, as disclosed in the above cited US Patent No. 5,590,166. However, and as described with relation to Fig. 1, in most mammography machines the bucky 15 is in a fixed or stationary position relative to the paddle, and only the paddle 14 is movable toward and away from bucky 15. Bucky 15 is fixedly mounted on the C-arm 11.

Importantly, since the inventive method requires a breast supporting surface that is movable relative to the bucky, and since most buckys are stationary or fixed, the present invention discloses a movable interface that is mounted on the fixed bucky. More specifically, and as will be described in detail, an inflatable and expandable pad 30 is disclosed that is mountable on the bucky 15, see Fig. 1, to provide a breast interface

element (hereinafter also referred to as a noun "interface") that provides a selectively movable surface for compressing the patient's breast. The pad 30 provides the means for controllably moving the breast toward the compression paddle to effect the inventive method, as will now be described.

Refer to Figs. 9-23 that show the inventive inflatable pads, generally labeled as 30 (the specific embodiments are labeled 30A, 30B, 30C and 30D) that are positioned on bucky 15 to provide and interface between the bucky and a patient's breast. The pads 30 are expandable and thus provide a movable surface required by the inventive method. The pads 30 are in the form of a flat rectangular configuration 32 to fit on the associated bucky 15. Pads 30 each include a top cover 31 and a bottom cover 32 forming an air chamber 39 there between. It is important that the top cover 31 and bottom cover 32 of the pads be of radiolucent material that will not significantly attenuate the X-ray beam, so that the imaging process is not adversely affected.

As shown in Figs. 10,12,15 and 19, the pads 30 include a suitable two-way air valve 40 that controls the air admitted to the air chamber 39 to inflate the pads. Air is preferred as the inflating medium. Other gases such as helium could be used to provide the pressure to expand the pad; however, air is a useful and available gas for this purpose. A liquid medium in lieu of air would unsatisfactorily attenuate the X-ray beam.

The valve 40 is coupled to a source of air through an air

line 43. The air source comprises an air pump 49 of any suitable known type that may be manually operated, battery operated or electrically operated; all three types of air pumps are commercially available. The air provided is at relatively low pressure but it is sufficient so that top cover 31 of pads 30 provides a firm support and firm compression surface. A suitable gage may be provided for pump 49 to monitor the air pressure provide to pads 30. The US Food and Drug Administration requires that a compression paddle provide a compression force of up to forty-five pounds; each embodiment of pads 30 should provide an equivalent counter force.

In the embodiment shown in Figs. 9-11 the pad 30A is made of radiolucent stretchable material and is molded (formed) in a rectangular container (box-like) shape that is generally inflatable with all the various surfaces being stretchable, as depicted in Fig. 11. A latex material may be used for the embodiment of pad 30A shown in Figs. 9-11. Fig. 10 shows the pad 30A in a partially expanded mode mounted on bucky 15, and Fig. 11 shows the pad 30A in an expanded mode.

In the embodiment of pad 30B shown in Figs. 12 and 13, the top cover 31A and the bottom cover 32A are of radiolucent material that is flexible but not stretchable. The sides 37A of pad 30A are also of material that is flexible but is not stretchable, for example a suitable cloth. Sides 37A may include

folds 38 that expand a given amount but limit the expansion of pad 30B. The folds 38 are indicated in an exaggerated condition in Fig.14 to emphasize the folds; in the expanded mode the folds 38 are essentially open or stretched. The pad 30A is designed to be inflated to expand up to a preselected maximum size (thickness) determined by the width of the material of sides 37A.

In one modification, the top cover 31A and bottom cover 32A of pad 30A may be of a thin sheet of radiolucent material such as PETG (polyethylene terephthalate glycol) plastic having a thickness in the range of 0.075 to 0.095 inches. The PETG material is relatively rigid but it is radiolucent so as to minimally impede the X-ray imaging beam.

Fig. 13 depicts a variation that may be added to pad 30B wherein a plastic roller 43 is affixed to the back end of pad 30B to extend parallel to the front and back sides. When is use, this variation of pad 30B is partially inflated and positioned on the bucky as in the other embodiments. Note that air is contained in the partially filled chamber 39. The roller 43 is rotatable to move in the direction indicated by the arrow line 47 to squeeze the top cover 31B and bottom cover 32B together (as in a toothpaste tube) to reduce the size of the chamber 39. The back section of the pad 30B is squeezed together causing the front section of the pad (the section positioned underneath the breast) to expand and push the breast toward the compression paddle.

The embodiment of the pad, labeled 30C shown in Figs.15-18,

is a hybrid of the pads 30A and 30B; that is, the front section 41 of the top cover 31C of the pad 30C is of material that is stretchable, and back section 41 of the top cover of pad 30C is made of material that is non stretchable. The materials are seamed or fused (welded) together, as is known. More specifically, the top cover 31C of the pad 30C is formed of two sections 41 and 42. Section 41 is made in a partially rounded pattern to accommodate the flattened form of a breast and is made of stretchable material. Section 42, including the part 49 of section 42 encircling section 41, is made of non stretchable material that is fused to stretchable section 41. The bottom cover 32B and sides 37B are made of non stretchable material as in pad 30A. In a partially inflated mode, the side view of pad 30B is a flat rectangular container of a first thickness as shown in Fig. 18. In the fully inflated mode the stretchable section 41 is expanded to provide an elevated breast compression platform that is of a thickness approximately twice the partially inflated thickness; see Figs.16 and 17 that show side views of the expanded pad 30C. Note that the stretchable portion 41 could extend straight across the top of pad 41, but the indicated pattern is deemed more attractive.

Fig. 19 shows a variation of the pad of Figs. 15-18. Pad 30D shown in Fig. 19 has a bottom cover and sides that are similar to those of pad 30B. The top cover 31C of pad 30C is formed as two sections 44 and 45. Section 44 is of expandable material and

section 45 (including the portion 49 encircling section 44) is of non expandable material. In a partial inflated mode of pad 30D, the expandable material 44 is molded such that, when pad 30D is in a partially expanded mode, section 44 forms a cradle 46 for receiving the patient's breast. Fig.20 is an end view of the pad 30D in its partially expanded mode that, in conjunction with Fig.19, clearly depicts the structure of the cradle 46. The cradle is approximately one-half of the thickness of the sides 37D of the pad. When the pad 30D is fully inflated, the cradle 46 section is expanded to be approximately level with the non stretchable section 44 to lift and compress the breast. Fig.21 depicts, in dotted lines, the partially expanded position of section 44, and in the solid lines 44A, the fully inflated and expanded section 44. Section 44 could also be formed as a depression straight across the top cover 31D, however a cradle configuration is deemed more attractive.

A tab 34 formed of relatively rigid plastic may be affixed to the front end of the pads 30 to extend down the front end of the pads. Tab 34 positions the pads 30 on the bucky and also holds the pads in position as the pads are being inflated from a partially inflated mode to a fully inflated mode. As the pads 30 are being fully inflated, the tab 34 is wedged (firmed) between the patient's chest wall and the bucky 15. Tab 34 thus holds the pads in a position that causes the top surface of the pads to push upwardly against the breast and not at an angle. Pushing

the breast at an angle tends to bunch or press the breast tissue against the chest wall instead of spreading the breast tissue as is desired. The tab 34 is preferably made of a thin plastic to assure that there is no interference with the X-ray imaging beam, or with the machine generally.

As is known, the C-arm 11 (on which the bucky is mounted) is rotated or tilted to take mediolateral oblique images of the breast. As indicated in Fig. 15, tabs 48 similar to tab 34 may be affixed to the side edges of any of the pads 30, the tabs will extend down the side of the bucky to properly position and retain the pads on the associated bucky, particularly when the bucky is tilted.

It should be appreciated that pads 30 of different sizes are provided to accommodate buckys of different dimensions. Also the thickness of inflation of the pad may be selectable as determined by the size, type and mass of the breast to be imaged.

In use, air is pumped into air chamber 19 of the pads 30 and the pads are inflated to attain a first partially expanded (inflated) mode. In the embodiments shown in Figs. 9-18 the partially expanded mode is approximately 1.75cm in thickness. The one pad 30 in use (either 30A, 30B or 30C) are next mounted on the bucky 15 and the compression procedure and the patient's breast is positioned on the top cover 31 of the pad. The pad now provides an interface element between the bucky 15 and the patient's breast. Next the compression paddle 14 is lowered to

engage and compress the patient's breast. As stated above, the compression paddle 14 is moved downwardly toward the bucky 15 to obtain less than the desired compression; it is believed that this is in the range of about 70% to 85% of the desired compression. Next, as also described above, movement of the compression paddle is stopped. The air pump 49 is then triggered by a suitable switch 41 to provide air under pressure through valve 40 to air chamber 39 to inflate and expand pad 30 to a selected width. The air is provided at a relatively slow flow to gently lift the top surface of pad 30 (up to a maximum of about 4.5cm) to force upwardly against the sagittal portion of the breast to compress the breast to the desired compression. The amount of inflation is controlled by the technician. The breast is now in the proper condition so that X-ray imaging can be initiated.

As mentioned, in the depicted embodiments of pads 30A, 30B, and 30C the partially inflated modes are about 1.75cm in thickness. Pad 30D is different in that the partial inflated mode of pad 30D are relatively much thicker, about 4.5cm; however the cradle 44 of pad 30D that forms a support interface for the breast is about 1.75cm in thickness. When pressure is applied to pad 30D, the surface of the cradle expands upwardly a controlled amount to an expanded position that can be up to the level of, or even higher than, section 45 of top cover 31D.

It can be appreciated, some "fine tuning" of the positions of the compression paddle 14 and the top surface 31 of the pads generally labeled 30, may be required to obtain the exact compression and positioning of the breast. That is, the spacing between the compression paddle 14 and the breast contacting surface of the pad 30 may have to be adjusted a small amount to obtain the precise desired compression, as for example by exhausting a small amount of air. The air valve 40 is a two-way valve that enables a technician to exhaust some air from the air chamber 39 if the compression is more than required, or more than can be accepted by the patient.

The exact amount of movement of the compression paddle and the pad 30 to obtain the required compression of patient's breast is determined by experience and training. As stated above, the precise or particular movement of the paddle and the pad 30 varies dependent on the size and configuration of the breast.

An inflatable and expandable pad 30 is quite ideal in view of the limited space available for positioning and operating the pad. Also, an inflatable pad is preferred in view of the requirement that there be minimal interference with the X-ray beam. Further for ease of application, an air inflatable pad is the preferred embodiment.

The inventive method is now further explained with reference to Figs.1, 22 and 23. The description above detailing the inventive method as relates to a movable bucky method and the

description of the inventive inflatable pad 30 have in essence already described the method as shown in Figs. 22 and 23. The following description relating to Figs. 1, 22 and 23 will address a few additional details. As shown in Fig. 1, in the initlal step of the inventive procedure, a pad 30 is initially inflated to its partially expanded mode (about 1.75cm in thickness) and mounted on the bucky 15. Importantly, the pad 30 functions as an expandable (upwardly movable) interface between the breast and supporting surface of the bucky. The patient's breast is positioned on the supporting interface provided by the partially expanded pad 30. Next, as shown in Fig.22, the compression paddle 14 is moved to engage the breast and compress the breast to less than the full selected compression; this is shown as "X + Y cm", where "X" indicates the spacing between the compression paddle 14 and the pad 30 interface to obtain the full desired compression. At this position, the movement of the compression paddle is now paused or stopped.

The term "Y" indicates the additional spacing or separation between the compression paddle 14 and the interface pad 30 that must be closed by the inflation and expansion of pad 30 to attain the full desired compression at position "X". Similarly as discussed, previously, in the position of the compression paddle 14 indicated in Fig. 22, it is believed that about 70% to 85% of the selected compression of the breast has been attained. As stated above, the spacing and percentages

indicated are variable and are not absolute numbers or amounts.

Fig. 23 depicts the next step of the inventive procedure wherein the pad 30 is inflated to its expanded mode to force the sagittal section 20 of the breast upwardly to attain the spacing "X",i.e., the full selected compression. As stated herein above, in the embodiments shown the partially expanded mode of pad 30 is about 1.75cm in thickness, and in its expanded mode, the pad can be inflated up to a maximum of about 4.5cm in thickness to attain the desire spacing "X". The patient's breast should now be in the proper position for taking an X-ray image.

As a modification of the method as described above, the compression paddle 14 and the pad 30 could be caused to move concurrently, that is, the pad could be inflating and expanding at the same time that the bucky is compressing the breast. However because of the variability of the size, configuration and firmness of the patients' breast (and the patient's comfort level and pain threshold), concurrent movement is not a preferred method.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.